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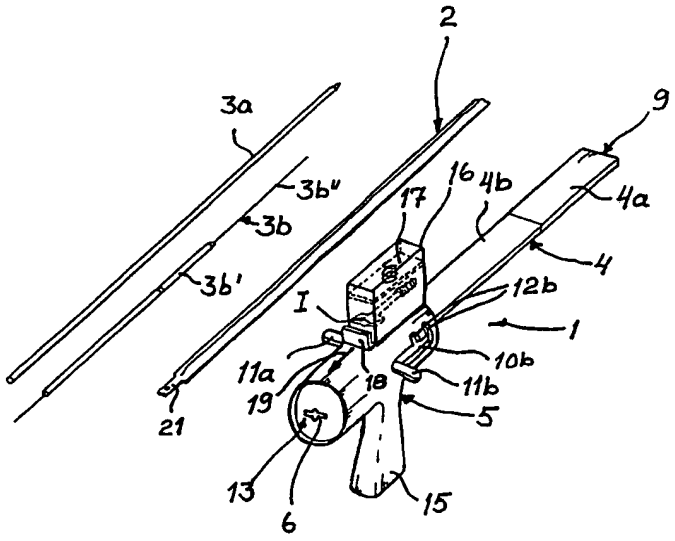

(57) Abstract

The invention relates to a surgical instrument for installation of a surgical implant in a living tissue, particularly in connection with a surgical operation. The installation instrument comprisng a frame (1) with an installation channel (6), in which the implant (I) is designed to be placed in the beginning of installation, as well as an installation part (2) arranged to be placed in the said installation channel (6) and to convey an external force needed for the installation of the implant (I) to the implant, the frame (1) being placed in connection with the tissue in a manner that the implant is placed in the said tissue when it exits the said installation channel (6) at the installation end (9) of the frame (1). The frame (1) comprises further at least one arresting means (7a, 7b) which in the operational position of the frame (1) has contact with the said tissue in order to arrest the installation end (9) of the frame (1) in position in relation to the tissue during the installation of the implant. The installation part (2) is equipped with means (21) for attaching the installation part (2) into a power transmission part (14) arranged to perform a reciprocating movement, whereby the said reciprocating movement is arranged to be transmitted as a periodical movement of the implant (I) through the installation end (9) of the frame (1) into the tissue.

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Surgical installation instrument

The present invention relates to a surgical instrument for installation of a surgical implant in a living tissue, particularly in connection with a surgical operation. The installation instrument comprises a frame with an installation channel, in which the implant is inserted in the beginning of installation. The instrument comprises further an installation part arranged to be inserted in the said installation channel and to convey an external force needed for the installation of the implant to the implant, the frame being placed in connection with the tissue in a manner that the implant is inserted in the said tissue when it exits the said installation channel at the installation end of the frame.

In this context, living tissue refers particularly to bone, ligament, connective tissue, synovial or joint tissue, muscular tissue, etc. Further, it can be stated that the important fields of applying the invention include corrective surgery of meniscal rupture as well as bone surgery as treatment of bone fractures. The installation instrument of the invention is suitable for use in arthroscopic surgery. In this invention, implant refers to a usually elongated macroscopic piece which is suitable to be surgically installed with a force effective thereon which moves the implant essentially in the direction of its largest dimension into the tissue. Implants of this kind typically include rod-shaped and arrow-shaped implants. As to arrow-shaped implants, reference is made in this context to the publication US-4,873,976 which discloses an arrow-shaped implant and a method for its installation to be used particularly in the repairing surgery of meniscal rupture. The implant is typically manufac-

tured of at least partially bioabsorbable polymer material.

In surgery, it is generally known to use installation instruments, typically manufactured of metal, for installing macroscopic implants, such as rods, hooks, pins, bolts and the like, in living tissues to connect operated or damaged tissues with each other or with other tissues. In such surgical installation instruments, the implant is typically placed at the initial stage either in part or wholly inside an installation channel in the installation instrument and forced from the installation instrument into the tissue by tapping manually with a hammer a special, typically piston-like installation part which conveys the force generated with the hammer to the implant and thus forces the implant to penetrate into the tissue. It is also known to use an application whereby the implant is forced into the tissue by one powerful, quick stroke effected on the implant e.g. mechanically, pneumatically, hydraulically or electromagnetically.

However, the surgical installation instruments of prior art used for installing macroscopic implants into a tissue have certain disadvantages. If the surgeon uses a manual instrallation instument, he/she needs both of his/her hands for controlling the instrument. By one hand the surgeon must support the frame of the surgical implant, wherein the surgical implant is inserted at least partly in the beginning of the installation operation. By the other hand the surgeon must tap the hammer or a corresponding tool, thus directing the force required for the transmission of the implant and conveyed by an installation part into the implant. Consequently, the surgeon cannot by his/her own hands keep in position that part or parts of the tissue which he/she will attach to each other with the implant. Thus, the surgeon must usually have

an assistant who keeps the parts of the tissue in position. As a result, the direct feel of the surgeon to the reactions of the tissue is essentially diminished as the operation proceeds. If the surgeon alternatively uses an installation instrument which forces the implant by one stroke into the tissue, his/her control over the installation procedure is very poor also in this case, because e.g. the direction or position of the implant thus cannot be changed as the installation operation proceeds, and the installation operation cannot be stopped after the implant has been triggered.

It is the object of this invention to present a surgical installation instrument of a new kind for use in the installation of macroscopic implants, deprived of the disadvantages of installation instruments of prior art as well as of factors delimiting the safety of patients. For achieving this aim, the installation instrument according to the invention is primarily characterized in that the said installation part comprises means for connecting the installation part to a power transmission part arranged to perform a reciprocating movement, whereby the said reciprocating movement is arranged to be transmitted as a periodical movement of the implant from the installation channel through the installation end of the frame into the tissue.

Application of the surgical installation instrument in the manner described above provides several advantages over the instruments of prior art.

Using an installation instrument of the invention, the surgeon can install an implant into a tissue by one hand, whereby he/she can by his other hand keep in position those parts of the tissue, through which the implant is intended to be forced. The surgeon can

thus control the installation operation better than with present methods, including correcting the position of the tissues during the installation operation when necessary. Also, the penetration of the implant effected by successive, quick strokes enables the surgeon to control the installation operation better than before, because he/she can e.g. change the direction of the installation instrument and/or the implant during the installation operation or interrupt the operation if necessary. This may be required e.g. in a case when the tissues to be attached to each other are displaced for any reason during the operation. The advantages of the installation instrument exerting quick reciprocating or vibrational movement can have the following theoretical basis: According to the viscoelastic theory, the modulus of viscoelastic material increases with an increase in the velocity of dynamic stress. In practice, this means that when an arrow-shaped implant is slowly penetrated into a viscoelastic connective tissue such as meniscal tissue, the meniscal tissue reacts as a soft material, yielding and tending to bend away from the implant penetrating into it. On the other hand, when the implant is vibrated step-by-step into the tissue utilizing a reciprocating movement by quick strokes of the installation instrument, the meniscal tissue will not react fast enough to the movement of the arrow-shaped implant in the manner of a soft material, but in a way it reacts as a hard material, not yielding with the forward movement of the implant anywhere near the extent as in manual penetration or stroke. The implant thus penetrates the meniscal tissue (or a preliminary hole made in it) easily without causing extensive transformation of the surrounding tissue.

In a particularly advantageous embodiment, the frame of the installation instrument comprises further at least one arresting means which is in the operational

position of the frame, in which case the installation part is inserted inside the installation channel, in contact with the said tissue in order to arrest the installation end of the frame in position in relation to the tissue during installation of the implant. As the frame can be locked in the installation end by the arresting means into the tissue for the time of the operation, the surgeon can secure the correct position of the installation channel before the actual phase of installing the implant.

Further, according to a preferred embodiment of the invention, at least one arresting means in the surgical installation instrument is arranged to be movable and lockable in relation to the frame, wherein the said arresting means in the non-operational position is placed inside the installation end of the frame and in the operational position protrudes from the installation end of the frame. In this application, it is possible to place the arresting means inside a tissue, particularly a soft tissue, in a way required by the surgical operation and the dimensions of the tissue in question. The arresting means can be advantageously locked at different penetration depths in relation to the frame in its operational position. For this purpose, the frame can be equipped with several locking means cooperating with a transfer and locking means placed in the arresting means and preferably controlled manually, which can be locked in position for locking the arresting means in a desired operational penetration depth.

Further, according to another preferred embodiment of the invention, the installation instrument comprises further at least one needle-like element with a cross-section at least partly formed in a manner that the needle-like element with a cross-section at least partly formed in a manner that the needle-like element

can be placed via the installation channel or a part thereof to bypass the installation end of the frame in order to make a preliminary hole or a like in the tissue before the installation of the implant, the installation end of the frame being placed in the installation position of the implant and arrested by at least one arresting means. This application provides the advantage of a smaller force required for the series of strokes by the installation part on the implant. As a natural consequence, the risk of an implant to be directed into an incorrect position and to be damaged is substantially reduced, because the forces effective upon it during installation are reasonable. This embodiment is particularly advantageous in connection with operations on tough fibrous tissues, such as meniscus, in which the margin of error is very small.

Further, according to still another advantageous embodiment, the frame of the installation instrument is at least partially formed of a transparent material.

Installation instruments of prior art are manufactured of metal material, particularly stainless steel. For this reason, these installation instruments have the disadvantage of not enabling the surgeon to evaluate visually the progress of the installation of the instrument and the condition of the implant. In particular, lack of visual contact with at least that part of the installation instrument where the implant is situated, i.e. the installation end of the installation frame of the instrument, complicates arthroscopic operations in which an operation is performed inside a joint by entering the installation instrument into the arthral chamber through a small incision and by controlling the stages of the operation by means of a special arthroscopic instrument which is entered into the arthral chamber either through

the same or another small incision. Consequently, the surgical installation instrument of the present invention can also be used to avoid this adverse factor present in installation instruments of prior art and thus to further increase reliability and safety of the installation to the patient.

Some advantageous embodiments of the surgical installation instrument of the invention are further presented in other appended, dependent claims.

In the following description, the surgical installation instrument of the invention will be illustrated further with reference to the embodiments shown in the appended drawings. In the drawings,

Fig. 1 shows a schematic perspective view of the surgical installation instrument, its first embodiment,

Fig. 2 illustrates the cross-section of the frame of the installation instrument shown in Fig. 1 in its longitudinal direction,

Fig. 3 shows a perspective view of a second embodiment of the surgical installation instrument, where the installation part is fixed in connection with a power transmission element,

Fig. 4 illustrates the cross-section of the frame of the installation instrument shown in Fig. 3 in its longitudinal direction, and

Figs. 5a-d illustrate schematically the phases of installation of an implant, particularly an arrow-shaped implant, into the meniscus.

With reference to Fig. 1, the installation instrument of the invention comprises as main parts a frame 1 and an installation part 2. Figure 1 illustrates also two needle-like elements 3a, 3b of the surgical installation instrument.

The frame 1 comprises a combination of an elongated installation frame 4 and an operational frame 5. The frame 1 is penetrated by an installation channel 6 whose cross-sectional form corresponds to the shape of the outer surface of the implant I as seen in the direction of the longitudinal axis of the implant. In the embodiment shown, the installation frame is made to have a flat cross-sectional form, e.g. a rectangular or oval form. The installation channel 6 is situated centrally in the direction of the greater dimension of the flat cross-sectional form in a way that arresting means 7a, 7b are located on both sides thereof in the same direction. The arresting means can be fixedly mounted or attached, or they are placed in corresponding arresting channels 8a, 8b in the frame, which extend in the direction of the installation channel. In the non-operational position, the arresting means, which are rod-like elements with a sharpened head and a circular cross-sectional form, are inside the installation end 9 or the frame 1. At the point of the arresting means, there is a longitudinal groove 10a, 10b on both sides of the operational frame 5, with protruding transfer and locking means 11a, 11b connected with the arresting means.

In the embodiment shown above, a transverse grooving 12a, 12b has been formed in the grooves 10a, 10b which is perpendicular to the longitudinal direction of the said grooves 10a, 10b and in which the transfer and locking means 11a, 11b can be placed when the arresting means is moved into the operational position

in the longitudinal direction of the arresting channel 8a, 8b and thus to protrude from the installation end 9 of the frame 1. The arresting means are locked by moving the said transfer and locking means 11a, 11b around the longitudinal axis of the arresting means into a desired groove of the transverse grooving 12a, 12b.

As mentioned above, the other end of the installation channel 6 is placed at the supply end 13 of the operational frame in a manner that that the installation part 2 can, fixed with the power transmission part 14 (Fig. 3), be inserted in the installation channel.

The operational frame is further equipped with a handle 15.

In the application shown in Fig. 1, the operational frame 5 further comprises a cassette or box 16 which can be changed in connection with the operational frame. A suitable number of implants I can be placed within the box 16 in advance, one being illustrated inside the box 16 with broken lines. In the embodiment shown, the implant I is an arrow-shaped element having a head and a stem at opposite ends of a body. The head comprises a scutellate or corresponding arresting structure, and the radial dimension of the stem is formed to exceed that of the body. In connection with a surgical operation on e.g. a meniscal rupture, as illustrated particularly in Fig. 5d, the head penetrates the meniscus at least partially, and the stem remains outside the meniscus to prevent an unintentional movement of the implant in the direction of installation. On the other hand, the scutellate or corresponding structure of the head cooperates with the stem, exerting a compressing force on the meniscus, particularly the rupture. This contributes to the

healing of the meniscus. In this connection, it should be pointed out that although the invention is illustrated with an example which is applicable particularly in surgical operations of the meniscus, it is clear that the surgical instrument of the present invention can be equally well applied in bone surgery, particularly in surgical operations on bone fractures, in connective tissue surgery and other surgery of the tissues of the musculosceletal system. Further, with reference to Fig. 1, the box 16 can comprise a spring-loaded plunger 17 which keeps the implants I in such an order in the box 16 that upon pulling a loading device 18 between the box 16 and the operational frame 5 e.g. in the direction of arrow 19, the next implant I is moved from the box 16 into the installation channel 6 within the operational frame, as shown schematically in Fig. 2. From this position, the implant I can, e.g. by using the installation part 2, be transferred to the installation end 9 of the installation channel.

In an advantageous manner, the surgical installation instrument of the invention is made to be at least partly transparent. In the embodiment of Fig. 1, the part at the installation end 9 of the installation frame 4 is made transparent. This transparent part 4a of the installation frame 4 can be advantageously manufactured as a disposable part which can be attached with snap-in fixing means to the stationary part 4b of the installation frame mounted on the operational frame 5. The snap-in fixing means are shown by the reference numeral 20 in Fig. 2. The transparent part 4a can be manufactured of a transparent polymer, copolymer or a polymeric mixture. Also ceramic materials are feasible. The transparent part 4a naturally comprises a part corresponding to the cross-sectional form of the installation channel as well as parts corresponding

to the arresting channel, whereby it is functionally fully compatible with the frame 1.

Figure 1 further illustrates the installation part 2 pertaining to the surgical instrument of the invention. This is an elongated rod-like formed piece with a cross-sectional form perpendicular to the longitudinal direction corresponding preferably to the cross-sectional form and size of the installation channel 6 of the frame 1. The length of the installation part is elected so that, connected with a power transmission part 14, it can act on the implant in the installation channel, particularly the stem, for the entire length of the installation channel. The other end part of the installation part 2 is equipped with a means 21 for attaching the installation part into the power transmission part 14 (Fig. 3). The reciprocating movement of the power transmission part 14 is arranged in a way that the installation part 2 moves backward and forward in its longitudinal direction (arrow L in Fig. 3).

Figure 3 illustrates an embodiment of the frame 1 where the implant is fed into the installation channel through an opening in the supply end 13 in the installation channel. Using the installation part 2 coupled with the power transmission part 14, the implant is entered into the installation end 9 of the frame 1 in the installation channel. The power transmission part 14 can be operated on a pneumatic, hydraulic and/or electromagnetic principle. The power transmission part 14 shown in Fig. 3 is arranged to work pneumatically, whereby it has a connecting means 14a for conveying compressed air into a piston arrangement inside the frame 14b of the power transmission part 14. Power transmission parts of this kind are available in different commercial applications, e.g. as reciprocating surgical bone saws, which can be applied with

minor technical modifications for use in combination with a surgical installation instrument of this invention. As an example of such power transmission parts, products marketed under the trademark HALL® can be named. Power transmission parts of this kind as well as their socket structures, in which the attaching means 21 of the installation part 2 (Fig. 1) is attached, are obvious to an artisan in the field and consequently not described more closely in this context.

Figure 4 shows an alternative application for combining the installation frame 4, which is preferably transparent, and the operational frame 5. The installation frame 4 is entirely formed of a transparent material, and its end is equipped with a flange 22 whereby it is attached (broken lines in Fig. 4) e.g. with a screw fastening to the end of the operational frame 5. An advantage of this arrangement is that installation frames 4 of different shapes can be used in connection with the same operational frame 5. It is a generally known fact that curved or bended forms of the installation frame 4 may be required in certain surgical operations in order to get at the tissue to be operated on. Consequently, a solution of this kind can broaden the field of use of the surgical installation instrument. Naturally in these cases flexibility is required of the material of the arresting means so that they can adjust to the shape of the installation frame 4.

Particularly Figs. 5a-5d illustrate schematically the phases of a surgical operation performed using a frame shown particularly in Figs. 3 and 4. The operation shown in Fig. 5 is a surgical repairing operation of a rupture R of the meniscus NK. This is performed preferably by arthroscopy. In the first phase shown in Fig. 5a, the arresting means 7a, 7b are pushed into the operational position by using the transfer

and locking means 11a, 11b, whereby the said arresting means can extend over the rupture. In this manner, the installation end 9 of the frame 1 is locked in position and at the same time the rupture R is immobilized and thus controlled. In the next phase according to Fig. 5b, a needle-like element 3a is entered via the installation channel 6 into the meniscus in order to make a preliminary hole. Figure 5b illustrates the use of a needle-like element 3a, but as shown particularly in Fig. 5c, also a needle-like element 3b of Fig. 1 can be used. It comprises two needle-like elementss, one inside the other, of which the outer one 3b' has a larger diameter and inside it is a relatively thin needle-like element 3b" by which the preliminary hole is lengthened after the outer needle-like element 3b' has substantially reached the center of the meniscus and passed the rupture, all the way through the meniscus. Thus a preliminary hole ER is formed as shown in Fig. 5c, comprising a part ER1 with a wider diameter and a part ER2 with a smaller diameter. The diameter of the needle-like element can correspond to the diameter of the body of the implant I, whereby the needle-like element can be moved in the installation channel along the wider middle section of the installation channel. This wider middle section is shown by the reference numeral 6a in Fig. 4. Particularly for the wider wing structure of the stem of the implant I, the installation channel 6 is provided with widenings shown by the reference numeral 6b in Fig. 4. Further, Fig. 5c illustrates the placement of the implant in the installation channel 6 all the way to the installation end 9 of the installation frame 4 using the installation part 2 which is coupled with the power transmission part 14. The implant I is pressed via the preliminary hole ER through the meniscus into a position shown in Fig. 5d. In this phase, the advantages of the surgical installation instrument of the present invention are obvious. The

arresting means 7a, 7b secure that the frame 1 is kept in position. The preliminary hole ER facilitates the installation of the implant. The transparent installation frame 4 provides immediate visual control of the position of the implant in the installation frame also during arthroscopy. Further, the most important operational advantage in this phase is the fact that the surgeon, while maintaining contact with the stem of the implant I with the head of the installation part 2, can observe the implant as it proceeds into the preliminary hole and stop the installation of the implant if necessary. Thus the implant can be installed into the tissue in stages by utilizing the reciprocating movement of the installation part and the simultaneous movement in the installation channel feeding the installation part.

It is obvious that the advantages presented above apply also to many other surgical operations than meniscal operations.

The installation instrument of the invention can be modified even to a high degree. One particular alternative for a frame, especially a transparent installation frame, is to fix the arresting means in connection with the transparent frame in a manner that they protrude from the installation end 9. Thus the arresting means 11a and 11b which can be moved and locked in relation to the frame 1 can be eliminated from the frame 1. It is also obvious that there can be only one, or more than two of the arresting means 7a, 7b placed in the same frame 1 to be moved and locked in relation to the frame 1, or to the transparent installation frame, protruding from the installation end 9 of the installation frame.

Obviously, the dimensions and shape of the surgical installation instrument can vary even considerably;

only a few applicable alternatives are shown in the appended drawings. In the embodiment shown in the drawings, the following dimensions can be brought up within the basic dimensions. The total length of the installation frame 4 can vary between 20 and 200 mm. The width and thickness of the flat cross-section of the installation frame 4 can be typically 3 to 6 mm and and 1 to 3 mm, respectively. The length of the operational frame 5 can be 20 to 120 mm, whereby the total length of the frame 1 varies between 40 and 320 mm. The penetration depth of the arresting means can be chosen by the transverse grooving to be e.g. 5-10 mm. The arrow-shaped implant used e.g. in meniscal surgery has a length of ca. 14 mm. The diameter of the body is ca. 1.5 mm, and the maximum radial dimension of the stem is 3 mm, the dimension of the stem length of the wing in the axial direction being ca. 1.5 mm.

One very important detail, it can be mentioned that according to practical measurements, good penetration of the implant into the meniscal tissue is achieved when the maximum rate of a single stroke of the vibrating movement is at least 300 m/min and the frequency of the strokes is higher than 1000/min (ca. 17/s), preferably ca. 10000-20000/min (ca. 170-340/s). If the stroke rate is in the order of 50 to 150 m/min, which is a typical stroke rate when slow vibration is performed manually by hitting a cylindrical piston with a suitable hammer, the piston conveying the stroke to the implant, the rate of the stroke is thus so low that the meniscal tissue reacts in a manner of a soft material, yielding and bending, whereby the implant does not properly penetrate into the tissue.

As to the implant presented in this invention, particular reference is made to the parallel patent application "Surgical implant" of the same applicant, where the structure of the implant is described in detail.

Claims:

1. Surgical instrument for installation of a surgical implant in a living tissue, particularly in connection with a surgical operation, the installation instrument comprising a frame (1) with an installation channel (6), in which the implant (I) is inserted in the beginning of installation, as well as an installation part (2) arranged to be inserted in the said installation channel (6) and to convey an external force needed for the installation of the implant (I) to the implant, the frame (1) being placed in connection with the tissue in a manner that the implant is inserted in the said tissue when it exits the said installation channel (6) at the installation end (9) of the frame (1), **characterized** in that the said installation part (2) comprises means (21) for connecting the installation part (2) to a power transmission part (14) arranged to perform a reciprocating movement, whereby the said reciprocating movement is arranged to be transmitted as a periodical or movement of the implant (I) from the installation channel (6) through the installation end (9) of the frame (1) into the tissue.

2. Surgical installation instrument according to claim 1, **characterized** in that the frame (1) comprises further at least one arresting means (7a, 7b) which is in the operational position of the frame (1), the installation part (2) being inserted inside the installation channel (6), in contact with the said tissue in order to arrest the installation end (9) of the frame (1) in position in relation to the tissue during the installation of the implant.

3. Surgical installation instrument according to claim 1 or 2, **characterized** in that the said at least one arresting means (7a, 7b) is arranged to be movable and lockable in relation to the frame (1),

wherein the said arresting means in the non-operational position is placed inside the installation end (9) of the frame (1) and, brought into the operational position, protrudes from the installation end (9) of the frame (1).

4. Surgical installation instrument according to any of claims 1 to 3, **characterized** in that the arresting means (7a, 7b) is stationary in relation to the frame (1) and protrudes from the installation end (9) of the frame (1).

5. Surgical installation instrument according to any of claims 1 to 4, **characterized** in that the installation channel (6) is arranged to penetrate the frame (1) in its longitudinal direction, and that the frame (1) comprises an arresting channel (8a, 8b) extending in the longitudinal direction of the said installation channel (6) to the installation end (9) of the frame, in which the rod-like arresting means (7a, 7b) is arranged to move in the longitudinal direction of the arresting channel (8a, 8b) and to protrude from the installation end (9) of the frame (1) in the operational position of the arresting means (7a, 7b).

6. Surgical installation instrument according to any of claims 1 to 3 or 5, **characterized** in that the frame (1) comprises a combination of an elongated installation frame (4) and an operational frame (5), whereby the operational frame (5) comprises means (11a, 11b, 12a, 12b) for moving the arresting means (7a, 7b) in relation to the frame (1) and to lock it stationarily in relation to the frame (1), particularly in the operational position of the arresting means (7a, 7b).

7. Surgical installation instrument according to any of claims 1 to 3, 5 or 6, **characterized** in that

the installation frame (4) has a flat cross-sectional form, whereby the said installation channel (6) is situated centrally in the direction of the greater dimension of the flat cross-sectional form in relation to two arresting means (7a, 7b) which are located on both sides thereof and placed to be movable in their longitudinal direction into corresponding arresting means (8a, 8b), both arresting means (7a, 7b) having corresponding means (11a, 11b, 12a, 12b) for moving and locking the arresting means (7a, 7b) in relation to the frame (1).

8. Surgical installation instrument according to any of claims 1-3 or 5-7, **characterized** in that the operational frame (5) comprises one or more locking means (12a, 12b), and that the arresting means (7a, 7b) are provided with a manually controllable transfer and locking means (11a, 11b) placed in connection with the the operational frame (5) and transferrable along a groove (10a, 10b) connected with the locking means (12a, 12b) to achieve contact between said transfer and locking means (11a, 11b) and said locking means (12a, 12b) in order to achieve locking between the frame (1) and the arresting means (7a, 7b).

9. Surgical installation instrument according to any of claims 1 to 8, **characterized** in that the frame (1) comprises a handle (15) located preferably in the operational frame (5).

10. Surgical installation instrument according to claim 1, **characterized** in that the reciprocating movement of the power transmission part (14) is arranged to be effected by a pressurized medium, such as pneumatically or hydraulically, and/or electromagnetically.

11. Surgical installation instrument according to any of claims 1 to 3, **characterized** in that it com-

prises further at least one needle-like element (3a, 3b) with a cross-section at least partly formed in a manner that the needle-like element can be placed via the installation channel (6) or a part (6a) thereof to bypass the installation end (9) of the frame (1) in order to make a preliminary hole (ER) or a like in the tissue before the installation of the implant (I), the installation end (9) of the frame (1) being placed in the installation position of the implant (I) and arrested by at least one arresting means (7a, 7b).

12. Surgical installation instrument according to claim 11, **characterized** in that a series of the said needle-like means (3a, 3b) is arranged in connection with the installation instrument in a way that the cross-sectional diameter of the parts in the series is of varying size, particularly in order to form preliminary holes (ER) of varying size and extending to different depths in the tissue.

13. Surgical installation instrument of any of claims 1 to 8, **characterized** in that the frame (1) is at least partially formed of a transparent material.

14. Surgical installation instrument according to claims 6 and 13, **characterized** in that the installation frame (4) of the frame (1), or at least the part (4a) close to the installation end (9) thereof, is at least partially manufactured of a transparent material.

15. Surgical installation instrument according to claim 13 or 14, **characterized** in that the transparent part of the frame (1) or the installation frame (4) is arranged to be disposable, and that the frame (1) is equipped with attaching means for receiving the attaching means or the like (20, 22) of the disposable transparent part.

16. Surgical installation instrument according to any of claims 13 to 15, **characterized** in that the installation frame (4) is entirely transparent.

17. Surgical installation instrument according to any of claims 4 or 13 to 16, **characterized** in that the arresting means (7a, 7b) is arranged to be stationary in connection with the installation frame (4) manufactured of a transparent material or in connection with a part (4a) of the installation frame (4) manufactured of a transparent material.

18. Surgical installation instrument according to claim 1, **characterized** in that the maximum rate of the stroke movement is at least 300 m/min and the frequency of the strokes is higher than 1000/min, preferably ca. 10000-20000/min.

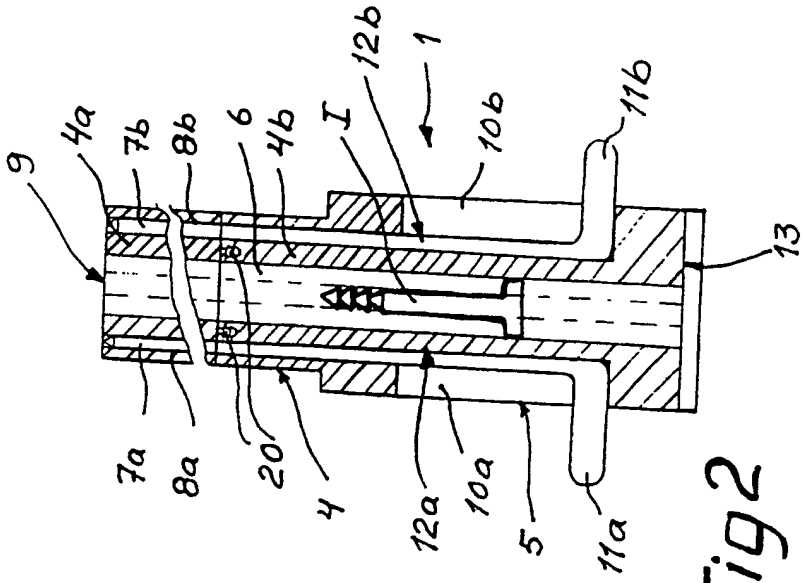
9
4a
7b
8b
6
4b
I
12b
1
10b
11b
13
7a
8a
20
4
12a
10a
5
11a

Fig2

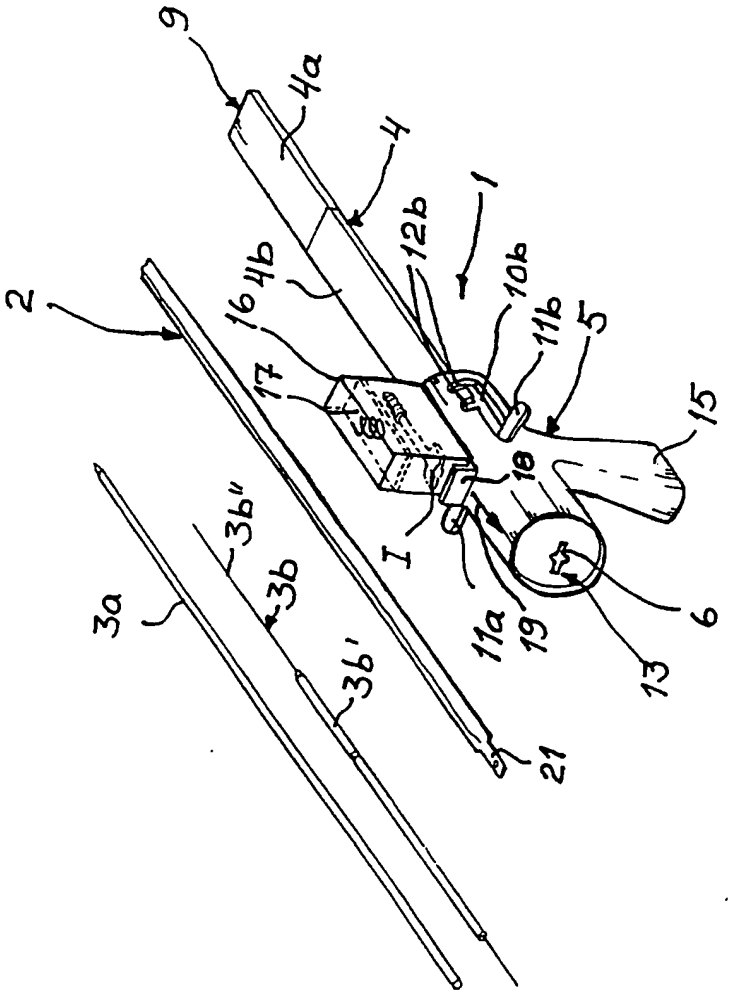
9
4a
4
12b
1
10b
11b
5
15
2
16
4b
17
18
I
3a
3b"
3b
3b'
11a
19
6
13
21

Fig1

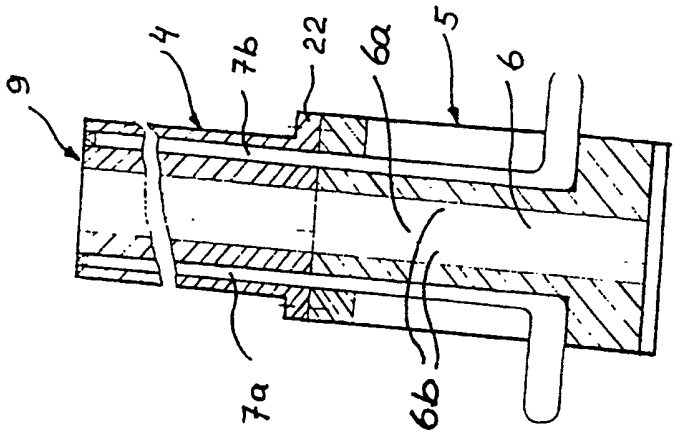

Fig 4

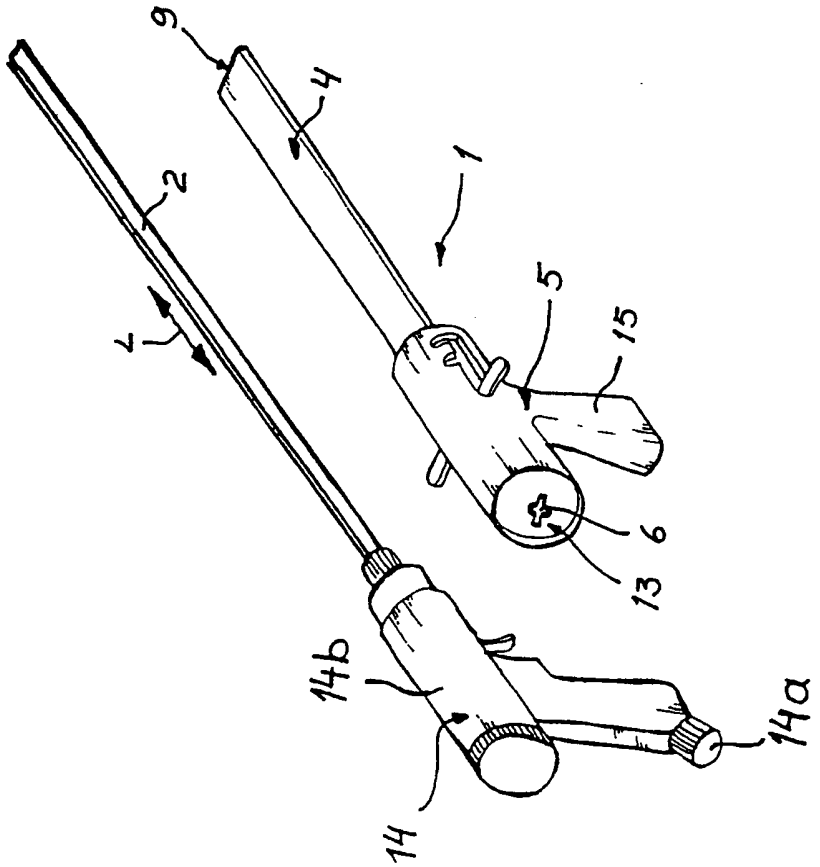

Fig 3

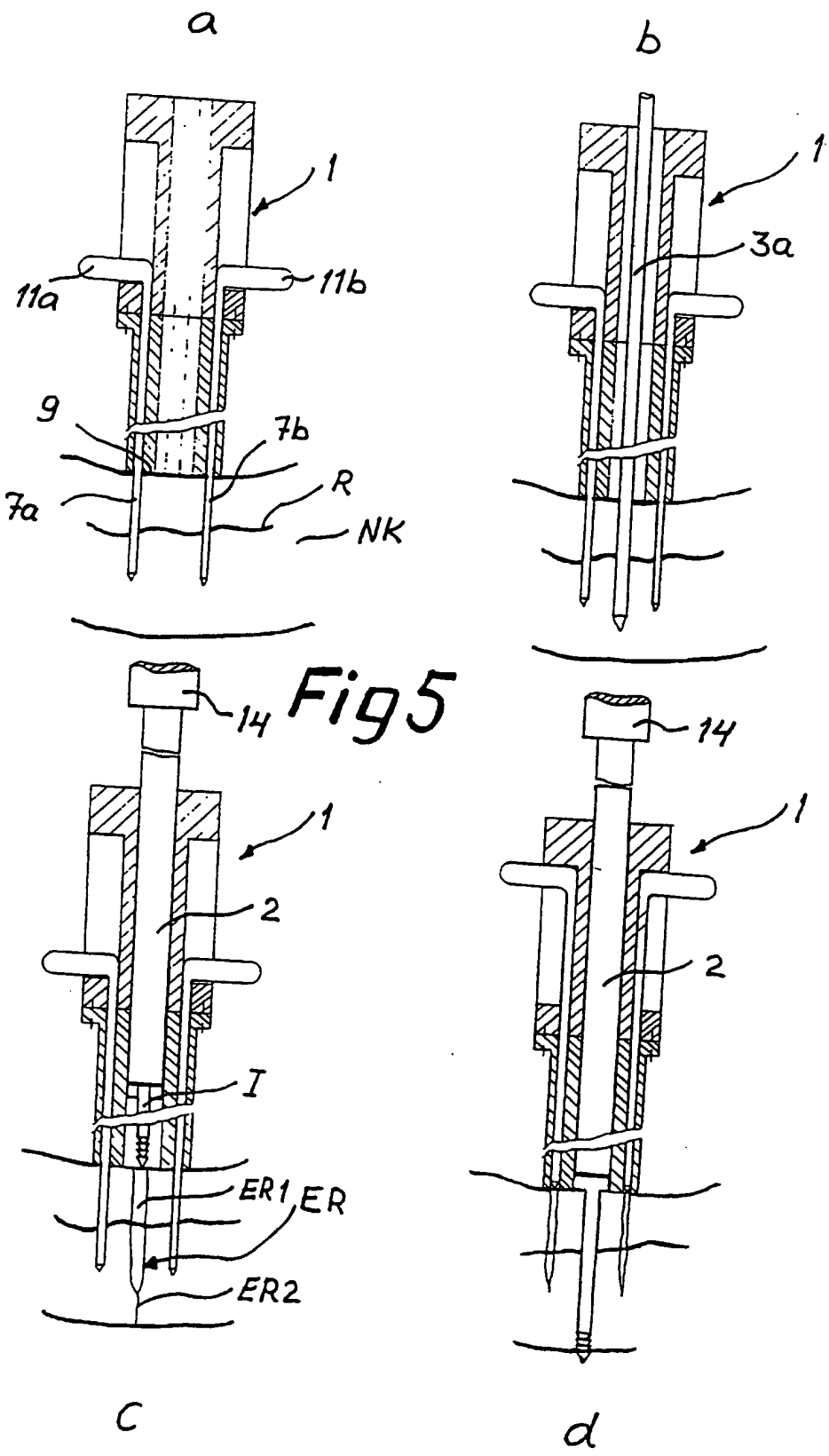

Fig5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 93/00015

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A61B 17/068, A61B 17/56
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5059206 (T.F. WINTERS), 22 October 1991 (22.10.91), figures 26-27 --	1-18
A	US, A, 4873976 (S.N. SCHREIBER), 17 October 1989 (17.10.89), figure 12, abstract --	1-18
A	EP, A2, 0130784 (MINNESOTA MINING AND MANUFACTURING COMPANY), 9 January 1985 (09.01.85), abstract -- --------	1-18

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 April 1993	03 -05- 1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Presto Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

31/03/93

International application No.
PCT/FI 93/00015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5059206	22/10/91	NONE	
US-A- 4873976	17/10/89	AU-A- 4066785	24/09/85
		EP-A- 0174361	19/03/86
EP-A2- 0130784	09/01/85	SE-T3- 0130784	
		AU-B- 570469	17/03/88
		AU-A- 2897084	03/01/85
		CA-A- 1237353	31/05/88
		JP-B- 4054462	31/08/92
		JP-A- 60020872	02/02/85
		US-A- 4540110	10/09/85